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UNIVERSITY OF PITTSBURGH BULLETIN

Vol. 17. July 23, 1921 No. 16.

SCHOOL OF MINES

1921-1922

PITTSBURGH, PENNSYLVANIA.
PUBLISHED BY THE UNIVERSITY.

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BOARD OF TRUSTEES OF THE UNIVERSITY OF PITTSBURGH

(Ex-Officio)

The Governor of the Commonwealth of Pennsylvania.
The Mayor of the City of Pittsburgh.
The Chancellor of the University.

Class I. Term expires June, 1924.

ELECTED		
1893	Andrew William Mellon	Pittsburgh
1900	James Henry Lockhart	Pittsburgh
1903	Thomas Harlan Baird McKnight	Pittsburgh
1903	Thomas Patterson	Pittsburgh
1911	John Knox McClurkin	Pittsburgh
1912	John Crawford Wallace	New Castle
1913	Alfred Reed Hamilton	Pittsburgh
1917	William Lewis Clause	Pittsburgh
1917	Benjamin Gilbert Follansbee	Pittsburgh
1919	Ogden Mathias Edwards	Pittsburgh

Class II. Term expires June, 1922.

1890	Benjamin Thaw	Pittsburgh
1904	William Lucien Scaife	Pittsburgh
1907	Joseph Clifton Trees	Pittsburgh
1908	Walther Riddle	Pittsburgh
1914	George Sturgis Oliver	Pittsburgh
1916	Richard Beatty Mellon	Pittsburgh
1916	The Governor of Pennsylvania	Harrisburg
1918	George Breed Gordon	Pittsburgh
1920	Charles Wesley Ridinger	Pittsburgh
1920	Isaac W. Frank	Pittsburgh

Class III. Term expires June, 1923.

1882	Rt. Rev. Cortlandt Whitehead	Pittsburgh
1889	William Jacob Holland	Pittsburgh
1902	George Hubbard Clapp	Pittsburgh
1906	Howard Heinz	Pittsburgh
1907	Andrew Jackson Kelly	Pittsburgh
1907	Samuel Alfred Taylor	Pittsburgh
1914	Henry Clay McEldowney	Pittsburgh
1920	David Aiken Reed	Pittsburgh
1920	William Penn Snyder, Jr.	Pittsburgh
1920	Homer David Williams	Pittsburgh

CALENDAR FOR 1921-1922

1921

Summer Session Registration	Fri.-Sat., July 1-2
Summer Sessions begins (ten weeks)	Mon., June 20
Summer Session ends	Sat., Aug. 27
First Semester Registration	Mon.-Sat., Sept. 19-24
First Semester and Fall Term classes begin	Mon., Sept. 26
Christmas Recess	Mon.-Sat., Dec. 19-31

1922.

Work Resumed	Tues., Jan. 3
First Semester ends	Sat., Feb. 4
Second Semester Registration	Mon.-Wed., Feb. 6-8
Second Semester classes begin	Thur., Feb. 9
Charter Day (Sunday, February 19) Celebration	Mon., Feb. 20
Easter Recess	Mon.-Sat., Apr. 10-15
Second Semester ends	Sat., June 10
Baccalaureate Sermon	Sun., June 11
Commencement	Wed., June 14

FACULTY

John Gabbert Bowman, A.M., LL.D., Chancellor.

Samuel Black McCormick, A.M., LL.D., Chancellor Emeritus.
S. B. Linhart, A.M., D.D., Secretary of the University.
John Gilbert Quick, B.S, Registrar.
Harry Bertine Meller, E.M., Dean, Professor of Mining.
Stephen Lincoln Goodale, A.M., E.M., Sc. D., Professor of Metallurgy.
Henry Leighton, A.B., Professor of Economic Geology.
Roswell Hill Johnson, M.S., Professor of Oil and Gas Production.
Ransom Evarts Somers, Ph.D., Professor of Oil and Gas Geology.
Robert Moffitt Black, A.B., B.S., E.M., Professor of Mining.
Erle Gladstone Hill, B.S., Assistant Professor of Metallurgy.
Sidney J. Lockner, M.S., Assistant Professor of Mathematics.
Louis Grow Huntley, B.S., Special Lecturer on Foreign Oil Fields.
Kenneth Dewitt Dodds, B.Chem., Assistant in Metallurgy.
Albert Budrow Howe, Pet.E., Assistant in Surveying.

GENERAL INFORMATION

The University of Pittsburgh.

The University of Pittsburgh is the oldest institution of higher learning west of the Allegheny mountains. As academy, college and university its history covers a full century and a third. Its career is almost exactly co-extensive with the life of the nation.

Founded by legislative enactment in 1787 as the Pittsburgh Academy, and reincorporated in 1819 as the Western University of Pennsylvania, the institution was transformed in 1908 into the University of Pittsburgh. It is only during the last thirty years that the institution, by a process of differentiation and adoption, has developed the twelve schools which make it a real university. Indeed, the most rapid expansion of the university has occurred within the twelve years since it removed to the present campus, the enrollment having increased about 500 per cent. in that time.

Not only was the University of Pittsburgh founded by the State but, throughout its history, it has been supported by state contributions for buildings and maintenance, at first in times of special need, latterly by regular biennial appropriations. As a servant of the State it has differentiated its work to meet, through its several special schools, a great variety of economic and social needs.

Though not sectarian, the University is Christian in the broadest sense of that term; namely, as training for the highest types of vocational and professional skill characteristic of modern Christian civilization. Throughout its career it has given Pennsylvania some of the most distinguished citizens of the Commonwealth.

The present organization of the University includes the following schools, named in the order of their founding: The College, School of Astronomy, School of Engineering, School of Law, School of Medicine, School of Pharmacy, School of Dentistry, School of Mines, School of Education, School of Economics, Graduate School, Mellon Institute.

A more complete history of the University may be found in the General Catalog.

The School of Mines was established by an act of the state legislature, approved July 5, 1895. Under the terms of the act, the school was intended to serve "the oil, gas and bituminous coal fields of this Commonwealth." An appropriation of $50,000 was made for initial expenses.

June 13, 1907, the sum of $175,000 was appropriated for a School of Mines building. Later recognition was accorded the school by an appropriation of $25,500, approved May 13, 1909, for the completion of the School of Mines building. The building appeared at the time of its completion to be adequate for the purpose, but gradually the necessities of the administration department and of other schools of the University required the releasing of much of the space.

In May, 1920, the School of Mines moved from State Hall, the School of Mines building, to some of the War Department buildings on the upper campus, where, under greatly improved conditions, there are offered well established courses in Mining (Coal and Ore), By-Product Coking, Metallurgy (Ferrous and Non-ferrous), and Petroleum Engineering.

LOCATION

The present site of the University, purchased in December, 1907, is forty-three acres in extent and forms a part of the historic Schenley Farms in Oakland. It is one block from the Schenley Hotel. The Memorial Hall, the Armory, and the Twentieth Century Club face the campus of the University. Only a few yards away are the buildings of the University Club, Athletic Club, the new Masonic Temple, and Syria Mosque. Three blocks distant is the magnificent Carnegie Institute, with its Museum, its Library, its Art, and its Music; and the Phipps Conservatory. Other public buildings are gathering around the same spot. The University is the center of the institutional and educational life of the city and of a great region round about.

The School of Mines occupies remodeled buildings formerly used by the Students Army Training Corps. These consist of a building 314 feet by 65 feet, in which are the laboratories for Mining, General Metallurgy, the Metallurgy of Iron and Steel, Ore Dressing and Fire Assaying; two buildings adjoining, each 50 feet by 65 feet, containing four large classrooms; and a two story building 152 feet by 40 feet containing the drafting room, the laboratories of Geology, Mineralogy, Petrography, Petroleum Engineering, and four classrooms.

Persons desiring to reach the School from down town or East Liberty should use the Center Avenue (Lincoln) car line to Center Avenue and Allequippa Street.

PURPOSE OF THE SCHOOL

The purpose of the School of Mines is so to train young men that they will be qualified to hold technical positions in one of the three great industries of the Pittsburgh District, namely: Mining, Iron and Steel Metallurgy, and Oil and Gas Production.

The location of Pittsburgh in the very heart of the bituminous coal fields of the Appalachian system, and in the most richly productive oil fields of Western Pennsylvania, with the great concentration here of mining, metallurgical and petroleum interests, makes this one of the most advantageous points in the United States for a school of this character. Use is made of these advantages by requiring the students, under proper supervision, to make trips to various mines and plants in the district as a part of their regular work. Each trip has a specific objective. The students are required to take notes and to make reports or solve problems based on the information gathered.

EQUIPMENT

LABORATORIES IN THE SCHOOL OF MINES

1. The Mineralogicial and Geological Laboratories. Their equipment is exceptionally complete, the laboratories ranking among the best in the country. Included are:

The Smith Cabinet. This collection was formed by the two sisters whose name it bears, and is rich in mineralogical and zoological specimens.

Mineralogical Collections. In addition to the Smith Collection there is a systematic, labelled collection of 3,500 specimens, numerous smaller sets illustrative of physical properties, crystallization, etc., and large amounts of exceptionally rich material for student use and identification. For crystallography there are large collections of small wooden models, and larger wooden, glass and pasteboard models for lecture use, as well as the latest instruments for crystal measurement.

PETROGRAPHICAL LABORATORY. This contains about 10,000 rock specimens and 5,000 thin sections for microscopic study, 10 petrographic microscopes and a number of the instruments used in more advanced optical mineralogy.

THE GEOLOGICAL LABORATORIES are equipped with numerous collections illustrative of geological phenomena, geologic maps and government reports, collections of fossils, models illustrating structural geology, etc., while through the courtesy of the Director and Trustees of the Carnegie Museum, with part of the staff, opportunity is afforded for the study of the excellent paleontological collections of the Carnegie Museum.

ECONOMIC GEOLOGY LABORATORY. The collection of material illustrative of Economic Geology includes suites of ores from most of the prominent mining districts, and suites of specimens of the more important nonmetallic minerals, such as coals, building stones and clays.

2. THE FIELD-INSTRUMENT EQUIPMENT includes a large assortment of the various types and makes of instruments used in land surveying, railroad surveying, construction work, leveling, geodetic surveying and mine surveying. The instruction of the student in the care, adjustment and use of the various types of instruments has been kept clearly in mind and well provided for in the selection of equipment.

3. THE MINING LABORATORY is equipped with models illustrating the principal systems of mining, hoisting, haulage, etc.; hand drills, breast drills, rock drills, coal-mining machines, miners' lamps (including electric lamps), apparatus for testing safety lamps, working model of mine fan, instruments for measuring the velocity of air currents, etc. Air and electricity are directly available as power, there being in the laboratory an air compressor and receiver, and a switchboard and complete wiring.

4. METALLURGICAL ANALYTICAL LABORATORY. This is equipped for metal, slag, etc. analysis, and for electrolytic experiments in metal plating and refining. Large laboratory tables with individual lockers are provided, a good hood, storage batteries, and the necessary electric meters for control. The stock room is conveniently available to the student.

The equipment for METALLOGRAPHY includes the necessary microscopes and photographic apparatus. The grinding and polishing apparatus and equipment for thermal analysis are located in an adjacent room. The dark rooms are suitably equipped and well ventilated.

The physical testing equipment of the School of Engineering is available for students in the School of Mines.

There is available for the laboratory study of IRON AND STEEL, equipment for microscopic and thermal analysis, the furnace laboratory for heat treatment, the forge shop, and the electric furnaces for making up special heats. Much of the equipment is particularly chosen to meet the needs of this work.

For the electric furnace work some 150 amperes of direct current is available from the University power plant; also some 600 amperes of alternating current from the Duquesne Light Company's lines which can be transformed to any desired voltage up to 220 volts.

5. **Furnace Laboratory.** This laboratory is provided with assay furnaces and melting furnaces; equipment for roasting and sintering, with tools, pyrometers, etc. Individual lockers are furnished students for special equipment.

6. **Ore Dressing Laboratory.** This laboratory is designed to illustrate the principles of crushing, screening, classification and concentration of ores, and of allied metallurgical processes, such as amalgamation, cyanidation and leaching.

A crushing and grinding equipment reduces ores from pieces 5 inches in diameter to pass 100 mesh screen.

Sizing and classifying apparatus is represented by several types. Small jigs, laboratory and half-size concentrating tables of different makes are provided, also slime tables and a well-equipped flotation laboratory, with supply of ores, oils, etc.

Cyanidation and other hydrometallurgical work are provided for by both leaching and agitating tanks, pressure and vacuum filters, etc.

7. **Fuels Laboratory.** The equipment here consists of rolls and screens for crushing and sizing, tables for washing, driers, a complete briquetting plant, laboratory apparatus to illustrate by-product coking process, and a steam boiler for fuel tests.

8. **The Oil and Gas Laboratory** is equipped with apparatus for experimental work in connection with the course in Petroleum Engineering, as well as for orginal research.

OTHER LABORATORIES USED BY THE STUDENTS OF THE SCHOOL OF MINES

The Chemical and Physical Laboratories in the College.

The Steam Laboratory, Engine and Power Laboratory, Materials Testing Laboratory, Hydraulic Laboratory, and **the Electrical Engineering Laboratories** in the School of Engineering.

The Pittsburgh Experiment Station of the United States Bureau of Mines, for the investigation of mine explosions and other factors relating to mining. Its work is available for the students, who are taught there: First Aid to the Injured and Mine Rescue Work, receiving certificates therefor from the United States Government and the American Red Cross.

LIBRARY FACILITIES

The Library. The total number of volumes in the University Library is about 24,000. A Reading Room is maintained in connection with the School, and is well supplied with the leading technical periodicals.

The Carnegie Library, with its immense collection of scientific books and periodicals, is near the University, and all of the files and collections are available for the use of students.

COOPERATIVE WORK.

Those expecting to enter the School of Mines are strongly urged to take the summer course in Surveying (or in Metallurgy) during the summer following the sophomore year in the College, so that the summer following the first year in the School of Mines will be free for cooperative work. Such students will be placed in a mine, a mill or smelter, or in the field, upon the same basis as other employes of the companies to which they are assigned, and will receive the same pay as others doing the same grade of work. Reports are made to the School periodically by the superintendents, and at the close of the summer written reports are required of the students.

Positions to which students are assigned cover all phases of the work in mining, metallurgy, geology, and oil and gas production. In addition to the Pittsburgh district students are placed in Arizona, Colorado, Idaho, Michigan, Minnesota, Montana, Missouri, New Mexico, Oklahoma, South Dakota, Texas, Canada, etc.

FINAL EXAMINATION FOR GRADUATION

At the end of the last year a comprehensive examination is conducted, which may include any of the work covered in the course, and which will be preceded by a review of the major subjects. The object of this examination is to insure that the student's work is properly correlated in his own mind, and that he is able to apply the principles of such subjects as mathematics and the sciences to mining, metallurgy, or oil and gas production.

TUITION AND FEES

The annual rate of tuition in the School of Mines is $210, payable in two installments, $110 upon registration at the opening of the first semester and $100 upon registration for the second semester.

The tuition for the first semester entitles the student to admission to all athletic events and certain other activities under the jurisdiction of the Advisory Board of Student Activities.

Full tuition is charged all students registering for twelve semester credits or more. The tuition charge for less than this number is at the rate of $7.00 a credit.

The tuition for the Summer Term in the School of Mines is $75.

A total of $840.00 for tuition must be paid before the degree is granted, even though the course may be completed in less than four years. Students entering with advanced standing are entitled to a proportionate adjustment.

Laboratory Fees covering the use of laboratories and equipment are charged in addition to the tuition as follows:

Biology	$5.00 per semester for each course
Chemistry	7.50 " " " " "
Physics	5.00 " " " " "
School of Mines	10.00 " " " " student

A charge is made for laboratory supplies and other materials used in courses requiring them. Supply Cards costing $5.00 each are provided for this purpose, and must be obtained at the Office of the Treasurer at the time of registration.

A fee of $5.00 is added to the tuition if registration is not completed within the dates specified.

A fee of $5.00 is charged for each examination for advanced standing without regard to the number of credits involved. The same fee is charged for every re-examination.

A fee of $10.00 for each diploma is due upon graduation. In the Graduate School an extra charge is made for the hood.

The above figures do not include charges for books, instruments, etc.

By action of the student body of the School of Mines each student is assessed $5.00 per semester to cover student activities of the School.

REFUNDS

No refund of tuition will be allowed if a student withdraws from a course after the middle of the semester or term. Application for refund will be considered only when made at the time of withdrawal.

HOUSING AND EMPLOYMENT BUREAU

The University inspects the boarding and rooming houses in the district and keeps a record of those which have been approved. During the week of registration a staff of workers assists students to find suitable lodgings and boarding places. At the time of the publication of this bulletin living expenses were reported to be as follows:

Per Week	Minimum	Average
Board	$8.00	$9.00-$10.00
Room	$3.00	$4.00-$ 5.00

These estimates are based upon actual facts, as discovered by careful investigation. There is, of course, a large personal variation in such expenses. To this estimate should be added the amount spent for laundry, amusement, etc.

Through the Employment Bureau every effort is made to help the student who is dependent upon his own resources. The Bureau has established definite relations with a large number of business and industrial concerns in the Pittsburgh District, and at the present time, these concerns depend almost entirely upon this agency to supply their part-time help. For information concerning this service apply to the Secretary of the Bureau, Room 1, State Hall.

DEPARTMENT OF PHYSICAL EDUCATION

Every student in the undergraduate schools, upon entering the University, is required to take a complete physical examination. This is made by the Department of Health and Physical Education during registration week and the following two weeks. Appointment for this examination is made at the time of registration. A record is kept of each case, together with a medical history, and the student is advised of any physical defects discovered and of ways and means for their correction. Subsequent physical examinations are made in cases requiring special attention. All candidates for athletic teams are carefully examined before being allowed to compete.

Physical education is required. The work must be taken during the freshmen and sophomore years, unless other arrangements are made with the head of the Department. Two 2-hour periods a week throughout the semester are required of all Freshmen and Sophomores. A minimum attendance of 75 per cent. is required. The two years' work necessary for graduation must include ability to pass a swimming test. In the case of those unable to swim, instruction in swimming may be Substituted for work on the gymnasium floor, two swimming periods being regarded as the equivalent of one gymnasium period. Exemption from gymnasium classes and credit for Physical Education are allowed for participation in athletics, upon recommendation of the coach and approval of the Director of Physical Education and Athletics.

RESERVE OFFICERS' TRAINING CORPS

The University maintains three units of the Reserve Officers' Training Corps, namely: Infantry, Coast Artillery, and Motor Transport. These units were established under provisions of acts of Congress for the purpose of furnishing men of education who will have sufficient training to act as officers in any army that the United States will have occasion to raise. The courses are divided into two 2-year periods. The first corresponds to the Freshman and Sophomore years; the second to the Junior and Senior years. Each period, once entered upon, becomes a prerequisite for graduation. The first period, known as the basic course, is designed to train men to act as non-commissioned officers in any future emergency. The second course, known as the advanced course, is designed to train men as officers.

In addition to the patriotic incentive, Congress has offered material inducements to students to take the course. The uniforms, equipment and textbooks are lent throughout the four years. The Government offers to students a money consideration known as commutation of rations, amounting approximately to $300.00 in the two years. The only demand made upon the student besides his University hours is for six weeks in the vacation between the Junior and Senior years at the training camp. All his expenses at this camp, including transportation, are paid. Upon graduation the student may receive a commission in the Officers' Reserve Corps if recommended by his instructors.

The University, co-operating with the Government, gives, as additional inducements, (a) University credits toward graduation and (b) Exemption from Physical Education, conditioned upon physical fitness. For further information concerning the R. O. T. C. apply to the Department of Military Science and Tactics.

REQUIREMENTS FOR ADMISSION

Beginning with the first semester of the year 1921-22, all applicants desiring to enter the School of Mines will be required to complete the work of the Freshman and Sophomore years in The College. Those previously registered in the School of Mines will continue therein, except the regularly classified student who has not acquired Sophomore standing by September, 1921.

The prerequisites for admission to the course in The College which fulfills the requirements for admission to the School of Mines include graduation from a first grade secondary school and the presentation of 15 units of preparatory work as follows:

SPECIFIC UNITS

Subjects	Units
English	3
Algebra	1½
Plane and Solid Geometry	1½
History	1
Foreign Language (Ancient or Modern)	2
Physics	1

ELECTIVE UNITS

The remaining 5 units may be offered from the following list, provided that the aggregate number of units (specific and elective) does not exceed the maximum indicated below:

Subjects	Maximum
English	4
American History or Am. Hist. and Civics	1
Ancient History (Greek and Roman)	1
Medieval and Modern History	1
English History	1
Algebra (through quadratics)	1
Algebra (beyond quadratics)	½
Trigonometry	½
Latin	4
Greek	3
German	4
French	4
Spanish	4
Physics	1
Chemistry	1
Physiography	1
General Science	1
Biology	1
Zoology	1

Botany	1
Economics	1
Physiology	½
Geology	1
Astronomy	1
*Agriculture	1
*Drawing	1
*Domestic Art	½
*Domestic Science	1
*Manual Training	1
*Fine Arts	½
*Industrial Arts	½
*Stenography	2
*Bookkeeping	2
*Typewriting	½
*Commercial Geography	½

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*Vocational Subjects.

Not less than ½ unit is accepted in any subject, and not more than 4 units in Vocational Subjects.

ADMISSION TO SCHOOL OF MINES

Students entering the University at the beginning of the year 1921-22 will be required to complete the following courses in The College in preparation for admission to the School of Mines. It is to be understood, however, that the arrangement of the courses is tentative and subject to revision as occasion may demand:

First Year

Courses	Credits
English	6
Human Progress	6
Mathematics	8
Physics	8
Chemistry	8
Graphics	2
Physical Education (Required)	0
Total	38

Second Year

English	6
Mathematics	8
Chemistry	8
Descriptive Geometry	2
Geology	6
Elective	6
Physical Education (Required)	0
Total	36

Students from other institutions having entrance requirements equivalent to those of the University of Pittsburgh and offering equivalent courses of study, will be given provisional credit for the work done and admitted to advanced standing without examination. If their work proves satisfactory, the provisional credits will be made permanent.

A few elective courses are provided for those who may enter with sufficient advance credits to allow time for such work, or those who may desire such additional preparation (see outline of studies). An elective course will not be given for less than five students.

APPLICATION

The attention of prospective students is directed to the following outline of the procedure of admission. By following these directions, confusion and delay will be avoided.

1. When the applicant has reached a decision to apply for admission, a request for an application blank should be mailed to the Registrar, Room 109 State Hall, University of Pittsburgh. In this request there should be a definite indication of the course in which the candidate is interested.
2. When this application blank has been received, it should be filled in according to instructions and returned without delay to the Office of the Registrar.
3. Upon receipt of this form, the Registrar will send for the record of the applicant's preparatory education and after these credentials have been examined the applicant will be notified concerning admission possibilities. If the entrance requirements have been satisfied a Registration Permit will be issued by the Registrar. This form must be presented at the time of registration.
4. Accompanying the Registration Permit will be a Vaccination Report Card. This form should be filled in and signed by the applicant's physician and returned at once to the Office of the Registrar. No registration will be allowed if this report is not filed.

REGISTRATION

Registration in the School of Mines will be conducted during the week of September 19, 1921. Candidates are advised to register early during the period as choice of sections in any of the courses will be possible only on condition of early registration.

OUTLINE OF COURSES

GROUP I
Engineer of Mines (E.M.)

GROUP II
Metallurgical Engineer (Met.E.)

GROUP III
Petroleum Engineer (Pet.E)

Page	Course No.	Title	Hours a Week Class	Lab.	Sem.	Prerequisite	Group I	II	III
16	Chem. 30	Fuel Analysis	1	6	2		x	..	x
16	Chem. 39	Nat. Debris & Hydrocarbons	4	6	1		x	..	x
16	Chem. 41, 42	Physical Chemistry	2	3	1, 2		..	x	x
16	Mech. 1, 2	Mechanics & Hydraulics	5	3	1, 2		x	x	..
16	Geol. 101, 102	Geological Methods	2	3	1, 2	With M. Geol. 1	..	..	x
16	Geol. 103, 104	Geological Lab.	0	6	1, 2	Geol. 101, 102		Elective	
16	Pal. 1, 2	Paleontology	0	3	1, 2		..	..	x
17	M. Geol. 1	Mineralogy	2	6	1		x	x	x
17	M. Geol. 2	Mineralogy	2	6	2	M. Geol. 1		Elective	
17	M. Geol. 3	Economic Geology	3	0	1	M. Geol. 1	x	..	..
17	M. Geol. 4	Geol. of Coal & Iron	3	0	2		x	..	..
17	M. Geol. 5	Ore Deposits	3	0	1	M. Geol. 3		Elective	
17	M. Geol. 7, 8	Petrography	1	6	1, 2	M. Geol. 2		Elective	
17	Sur. 1	General Surveying	8 weeks	Summer			x	..	x
18	Sur. 2	Railroad Surveying	2 weeks	Summer		Sur. 1	x	..	x
18	Sur. 3	Underground Surveying	2 weeks	Summer		Sur. 1, 2	x	..	..
18	Sur. 5, 6	Sur. Methods in Pet. Geol	0	3	1, 2	Sur. 1, 2	..	..	x
18	Mine 1	Principles of Mining	5	0	1		x	x	x
19	Mine 2	Practice of Mining	5	0	2	Mine 1; Mech. 1, 2	x	..	..
19	Mine 3	Practice of Mining	5	6	1	Mine 2	x	..	..
19	Mine 4	Practice of Mining	3	6	2	Mine 3	x	..	..
19	Mine 6	Graphic Statics	1	6	2		x	..	..
19	Mine 107, 108	Power Plant & Machinery	3	6	1, 2	Mine 3, 4		Elective	
20	Mine 110	Engineering Construction	..	..	2	Mine 4		Elective	
20	Mine 112	Appraisal	3	6	2	Econ. M-5; Mine 4		Elective	
20	Mine 113	Mining Law	2	0	1	Econ. M-3; Mine 1		Elective	
20	Mine 14	First Aid & Mine Rescue	Total of 30 hrs.		2		x	x	x
20	Met. 1, 2	General Met. & Ore Dressing	4	6	1, 2	M. Geol. 1	x	..	..
20	Met. 3, 4	General Met. Principles	3	6	1, 2	Preceded by or taken with Chem. 41, 42	..	x	..
21	Met. 5, 6	Iron Blast Furnace	2	6	1, 2	With Met. 3, 4	..	x	..
21	Met. 7, 8	Manufacture & Properties of Steel.	4	6	1, 2	Met. 3, 4	..	x	..

OUTLINE OF COURSES

GROUP I	GROUP II	GROUP III
Engineer of Mines (E.M.)	Metallurgical Engineer (Met.E.)	Petroleum Engineer (Pet.E)

			Hours a Week				Group		
Page	Course No.	Title	Class	Lab.	Sem.	Prerequisite	I	II	III
21	Met. 9, 10	Met. Calculations	3	0	1, 2	Met. 3, 4	..	x	..
21	Met. 111, 112	Electro-Metallurgy	2	6	1, 2	Chem. 41, 42; Met. 3, 4	..	x	..
21	Met. 13	Copper, Lead, Minor Metals	3	6	1	Met. 1, 2		Elective	
21	Met. 14	Gold and Silver	2	6	1 or 2	Met. 1, 2		Elective	
21	Met. 115, 116	Metallography	2	6	1, 2	Preceded by or taken with Chem. 41, 42	..	x	..
21	Met. 17, 18	Ore Dressing	3	6	1, 2	Met. 1, 2		Elective	
21	Met. 19	Preparation & Use of Fuels	2	6	1	Chem. 30, 39; Mine 2	x	..	..
22	Met. 20	Concentration of Iron Ores	1	6	2	Chem. 30, 39; Mine 2	x	..	..
22	Oil 101	Geology of Oil & Gas	4	3	1	M. Geol. 1	..	..	x
22	Oil 102	Comparative Oil Fields	4	6	2	Oil 101	..	..	x
22	*Oil 103	Business of Oil & Gas Production	2	0	1	Geol. 101, 102; Oil 101, 102	..	..	x
22	*Oil 104	Technology of Oil & Gas Production	2	0	2	Geol. 101, 102; Oil 101, 102	..	..	x
22	*Oil 105	Appraisal	2	0	1	Geol. 101, 102; Oil 101, 102	..	..	x
22	*Oil 106	Exam. and Reports	0	9	2	Oil 105	..	..	x
22	*Oil 107	Oil & Gas Lab.	0	12	1	Geol. 101, 102; Oil 101, 102	..	..	x
23	*Oil 108	Adv. Oil & Gas Lab.	0	9	2	Geol. 101, 102; Oil 101, 102	..	..	x
23	Oil 9	Chem. & Refining of Pet.	2	6	1	Chem. 39; Geol. 101, 102; Oil 101, 102	..	..	x
23	Econ. M-2	Principles of Economics	5	0	2		x	x	x
23	Econ. M-3	Business Law	2	0	1	Econ. M-2	x	x	x
23	Econ. M-4	Contracts & Specifications	2	0	2	Econ. M-3	x	x	x
23	Econ. M-5, 6	Economics of Mineral Technology.	5	0	1, 2			Elective	
23	Sem. 1, 2	Seminar	1	0	1, 2		x	..	..
23	Sem. 103, 104	Seminar	2	0	1, 2		x	..	..
23	Sem. 5, 6	Seminar	1	0	1, 2		..	x	..
23	Sem. 107, 108	Seminar	2	0	1, 2		..	x	..
24	Sem. 9, 10	Seminar	3	0	1, 2		..	..	x
24	Sem. 111, 112	Seminar	3	0	1, 2		..	..	x
24	Sem. 113, 114	Seminar	2	0	1, 2			Elective	

*Otherwise properly qualified graduate students may take one or more of these courses with Oil 101, 102.

DESCRIPTION OF COURSES

CHEMISTRY

Professors Engelder, Lowy and Stegeman.

30. Fuel Analysis *2nd Semester*

Analysis of natural gas, artificial gas, flue gases; gas calorimetry; analysis and calorimetry of coal; analysis and physical testing of oils. 1 lecture or recitation, 6 hours laboratory per week. Required in Groups I and III.

39. Natural Debris and Hydrocarbons *1st Semester*

Special emphasis is laid on occurrence, preparation, properties and uses of carbon and hydrocarbons. 4 lectures or recitations, 6 hours laboratory per week. Required in Groups I and III.

41, 42. Physical Chemistry *1st & 2nd Semesters*

A study of the laws governing chemical phenomena. The second semester is devoted to a consideration of the theoretical principles and some practical applications of electrochemistry. 2 lectures or recitations, 3 hours laboratory per week. Required in Groups II and III.

MECHANICS

Professor Lockner.

1, 2. Mechanics and Hydraulics *1st & 2nd Semesters*

Analytic Mechanics, Mechanics of Materials, Hydraulics. 5 lectures or recitations, 3 hours laboratory per week. Required in Groups I and II.

GEOLOGY

Professors Johnson and Somers.

101, 102. Geological Methods *1st & 2nd Semesters*

A training course for men who intend to do field work in geology. General scientific method. Specific geological methods. History of geology from standpoint of method. Study of carboniferous and cretaceous geology from standpoint of method. 2 lectures or recitations, 3 hours laboratory per week. With Mining Geology 1. Required in Group III.

103, 104. Geological Laboratory *1st & 2nd Semesters*

Work upon a series of problems adapted to the needs of the particular student, or research in one problem. 6 hours per week. Prerequisite: Geology 101, 102. Elective.

PALEONTOLOGY

Professor Ortmann.

1, 2. General Paleontology *1st & 2nd Semesters*

This course is intended to present a general survey of the field of Invertebrate Paleontology, the rich resources of the Carnegie Museum providing splendid facilities for study. 3 hours per week. Required in Group III.

MINING GEOLOGY

Professor Leighton.

1. **Mineralogy** *1st Semester*

After a summary of the subject of crystallography and determinative mineralogy, one hundred of the more common minerals are described and studied. This is followed by a study of the common rocks. 2 lectures or recitations, 6 hours laboratory per week. Required in all groups.

2. **Minecalogy** *2nd Semester*

A more detailed course planned to follow Mining Geology 1 and to enter more thoroughly into the subject of crystallography and determinative methods, with a study of an additional 150 minerals of importance to the mining engineer. 2 lectures or recitations, 6 hours laboratory per week. Prerequisite: Mining Geology 1.

3. **Economic Geology** *1st Semester*

A short course designed for those wishing a rapid survey of the mode of occurrence, distribution and uses of the more important mineral resources, both non-metallic and metallic. 3 lectures or recitations. Prerequisite: Mining Geology 1. Required in Group 1.

4. **Geology of Coal and Iron** *2nd Semester*

A study of the coal and iron ore fields of the United States from a geological standpoint with brief reference to important foreign fields. 3 lectures or recitations per week. Required in Group 1.

5. **Ore Deposits** *1st Semester*

A study of the theories of ore deposition and their application to the ore deposits of the important districts of the United States and to some of the foreign localities. 3 lectures or recitations per week. Prerequisite: Mining Geology 3. Elective.

7, 8. **Petrography** *1st & 2nd Semesters*

A study of optical crystallography, the determination of minerals by optical methods, and the determination and classification of rocks by means of the petrographic microscope. 1 lecture or recitation, 6 hours laboratory per week. Prerequisite: Mining Geology 2. Elective.

SURVEYING

Professors Black and Somers and Mr. Howe.

1. **General Surveying**

Standardizing of pace; practice in pacing; adjustment of hand level; determination of elevations with hand level; staking of mining claim and filing notice of location; topographic survey of mining claim by pacing and hand level.

Adjustment of compass; compass traverse; adjustment of transit; repetition traverse; azimuth traverse; farm survey with transit, computation of farm acreage; United States public land survey; layout of city streets, blocks, and lots; adjustment of plane table and alidade; topographic survey with plane table; adjustment of stadia; topographic survey with transit and stadia; official survey of mining claim; adjustment of engineer's level; leveling between bench marks.

Standardizing of steel tape; measurement of base line; triangulation, including practice in reading angles, computation and adjustment of system; solar observations for azimuth, latitude and time; observation on Polaris for azimuth, latitude and time.

Maps are required of the mining claim pacing survey, mining claim official survey, the compass, azimuth and repetition traverses, farm survey, city survey and stadia survey.

The class is divided into squads, usually of four men each, each man being required to do every kind of work with every instrument used, make a full set of notes of the work done by his squad, and from these notes make the maps in the drafting room.

50 hours a week, 8 weeks, Summer Term. Required in Groups I and III.

2. RAILROAD SURVEYING

Reconnaissance with aneroid and pocket compass; preliminary survey with transit, chain and engineer's level; topography with hand level; paper location; computation of simple and compound curves; final location of tangents and curves with transit and steel tape; leveling for profile; cross sectioning; computation of cuts and fills; computing and staking of turnouts, frogs and switches.

Each student is assigned his quota of every kind of field work, required to make a complete set of notes of the surveys and to prepare his individual maps, etc. The maps required are those of the reconnaissance, preliminary survey with paper location and the final location. The profiles and cross-sections also are plotted.

50 hours a week, 2 weeks, Summer Term, Prerequisite: Surveying 1. Required in Groups I and III.

3. UNDERGROUND SURVEYING

Underground practice in traversing; survey of secondary opening; surveying for details; shaft plumbing by various methods; use of auxiliary telescope and other instruments for steep sighting.

50 hours a week, 2 weeks, Summer Term, Prerequisite: Surveying 1, 2. Required in Group 1.

5, 6. SURVEYING METHODS IN PETROLEUM GEOLOGY *1st & 2nd Semesters*

Training in the use of instruments, especially plane table and stadia, to fit men for work as assistants in the field. 3 hours a week. Prerequisite: Surveying 1, 2. Required in Group III.

MINING

Dean Meller and Professor Black.

1. PRINCIPLES OF MINING *1st Semester*

A brief course, covering the subject fully in outline, but enlarged upon later for those specializing in mining. Includes: History of mining, prospecting, boring, placer mining, rock drills, explosives, surface mining, methods of entry, shaft sinking and tunneling, support of excavations, methods of mining, mining machinery, gases, lighting, ventilation, haulage, hoisting, drainage, surface plant, accidents, "Safety First," labor welfare, sanitation, organization of working force. 5 lectures or recitations per week. Required in all groups.

2, 3, 4. PRACTICE OF MINING *3 Semesters*

These courses amplify the subjects treated in Mine 1, where that treatment is not sufficiently comprehensive for the engineer interested primarily in mining operations. Both the technical and commercial aspects are treated. Special emphasis is placed on the mining of iron ore and coal. Numerous mathematical and other problems, similar to those met in actual engineering practice are introduced in order to apply the principles covered, and a considerable amount of original and individual work is expected. As far as possible, the problems form a series, based on data relating to a hypothetical mine and plant. There are numerous applications of subjects previously covered, such as the courses in graphics, mathematics, mechanics, physics, chemistry and geology. Special emphasis is laid on the most recent practice. Working mines in Pennsylvania and adjacent states are used for purposes of illustration.

Subjects treated somewhat in detail are as follows:

Power Plant—Steam, compressed air and electric; practical tests on each in laboratory and at mines.

Mine Machinery—Steam, compressed air, electric and gasoline; study of consumption, efficiency and cost of operation. Equipment for haulage, hoisting, drainage, ventilation, coal mining, and rock drilling is considered.

Mine Gases, Ventilation and Lighting.

Mine Mapping—Recording, tabulating and computing survey notes; making of maps from survey notes. Special problems of underground surveying with illustrations from surveys previously mapped; use of planimeter and pantograph.

Plant Design—Preparation of working drawings for the ordinary timber and steel surface structures, such as head frame, tipple, ore bin, boiler house, etc.; preparation of bills of material and cost estimates.

Law—Revised Statutes and subsequent Acts of Congress, together with Land Office procedure; mining laws of Pennsylvania and other coal mining states.

Hours per week for Mine 2: 5 lectures or recitations; for Mine 3: 5 lectures or recitations and 6 hours laboratory; and for Mine 4: 3 lectures or recitations and 6 hours laboratory. Prerequisite: Mine 1, Mechanics 1. Required in Group I.

MINE 6. GRAPHIC STATICS *2nd Semester*

Graphic solutions for stresses in the members of roof trusses, bridge trusses and other statically determinate framed structures. Methods for dead, snow, wind and moving loads and moment of inertia; also for bending moment, shear and deflection in beams under concentrated and uniform loads. 1 lecture or recitation, 6 hours laboratory per week. Required in Group I.

107, 108. POWER PLANT AND MACHINERY *1st & 2nd Semesters*

A detailed and critical study of power generation, transmission and use in machines adapted to mine requirements. Steam, compressed air, electricity and gasoline are treated. Tests are made on equipment under working conditions at the mines. 3 lectures or recitations, 6 hours laboratory per week. Prerequisite: Mine 3 and 4. Elective.

110. ENGINEERING CONSTRUCTION *2nd Semester*

A continuation of the subject of Plant Design treated in other courses, but including a greater variety of problems and involving additional principles. Trestles, dams, foundations and structures of masonry and reinforced concrete are designed, as well as mine cars, cages and skips. Statically indeterminate structures are treated. Prerequisite: Mine 4. Elective.

112. APPRAISAL *2nd Semester*

A study of the factors determining the value of a producing mine or a prospect. 3 lectures or recitations, 6 hours laboratory and library per week. Prerequisite. Econ. M-5 and Mine 4. Elective.

113. MINING LAW *1st Semester*

Analysis of state mining laws; study of court decisions in the United States affecting mining; study of laws relating to mineral land title and mining practice in Canada, Mexico and other countries. 2 lectures or recitations per week. Prerequisite: Econ. M-3; Mine 1. Elective.

14. FIRST AID AND MINE RESCUE WORK *2nd Semester*

Treatment of bruises, sprains, fractures, shock, burns, gas poisoning, etc.; principles, design and use of the helmet and mouth-breathing devices, resuscitation apparatus, and in the methods of mine rescue work. Total number of hours, 30, taken during Easter recess. Required in all groups.

METALLURGY

Professors Goodale and Hill and Mr. Dodds

1, 2. GENERAL METALLURGY AND ORE DRESSING *1st & 2nd Semesters*

This course will serve as a basis of metallurgical knowledge for those specializing in mining, or as a beginning course for those desiring to follow non-ferrous metallurgy. It covers the methods of winning the common metals from the minerals in which they occur in nature, the properties and uses of metals and alloys, and the study of refractories, fuels and other materials, as well as the apparatus used in metallurgical operations. The metals chiefly studied are iron and steel, copper, lead, gold and silver; and less completely zinc, tin, nickel, etc. 4 lectures or recitations, 6 hours laboratory per week. Prerequisite: Mining Geology 1. Required in Group I.

3, 4. GENERAL METALLURGICAL PRINCIPLES *1st & 2nd Semesters*

The introductory course for those students specializing in metallurgy. Includes a study of the materials used in metallurgical works, such as fuels and refractory materials, and also the metals, alloys and other products of those works, and the operations by which they are produced. The laboratory work follows closely the class work and is concerned largely with the measurements by which the above processes are controlled, and with a study of the materials themselves in the laboratory. 3 lectures or recitations, 6 hours laboratory per week. To be preceded by or taken with Chem. 41, 42. Required in Group II.

5, 6. THE IRON BLAST FURNACE *1st & 2nd Semesters*

A study of the design, construction and operation of the blast furnace and its accessories. 2 lectures or recitations, 6 hours laboratory per week. To be taken with Met. 3, 4. Required in Group II.

7, 8. THE MANUFACTURE AND PROPERTIES OF STEEL *1st & 2nd Semesters*

The design, construction and operation of the various furnaces and machinery used in the refining of pig iron and manufacture of steel, wrought iron, etc. The laboratory work includes a study of the metals with the microscope and experiments in reduction and refining. 4 lectures or recitations, 6 hours laboratory per week. Prerequisite: Met. 3, 4. Required in Group II.

9, 10. METALLURGICAL CALCULATIONS *1st & 2nd Semesters*

Calculations relating to the design of metallurgical apparatus, the quantities of heat and material required in operations, and the cost involved. 3 lectures or recitations per week. To be taken with Met. 3, 4. Required in Group II.

111, 112. ELECTRO-METALLURGY *1st & 2nd Semesters*

Electro-thermic and electrolytic methods applied to the recovery of metals from their ores, and the refining of metals. 2 lectures or recitations; 6 hours laboratory per week. Prerequisite: Chem. 41, 42; Met. 3, 4. Required in Group II.

13. COPPER, LEAD, MINOR METALS *1st Semester*

An advanced course supplementing Met. 1, 2, taking up a more detailed study of the furnaces and other apparatus used, the operations involved and methods of control. 3 lectures or recitations, 6 hours laboratory per week. Prerequisite: Met. 1, 2. Elective.

14. GOLD AND SILVER *1st or 2nd Semesters*

The metallurgy of gold and silver, with special reference to the hydrometallurgy or leaching processes, such as cyanidation, chlorination, etc.; the refining of bullion by different methods. 2 lectures or recitations, 6 hours laboratory per week. Prerequisite: Met. 1, 2. Elective.

115, 116. METALLOGRAPHY *1st & 2nd Semesters*

The study of metals and alloys, their structure, properties. The work of this course includes microscopic methods of study, and also chemical and physical testing and investigation of the properties of metals. 2 lectures or recitations, 6 hours laboratory per week. To be preceded by or taken with Chem. 41, 42. Required in Group II.

17, 18. ORE DRESSING *1st & 2nd Semesters*

A course designed for those students desiring to have a more complete knowledge of this subject. A more detailed study of principles involved, a closer study of flotation will be made. Considerable latitude will be allowed in laboratory work, in order to give the student particular study of some phase in which he may be interested. 3 lectures or recitations, 6 hours laboratory per week. Prerequisite: Met. 1, 2. Elective.

19. PREPARATION AND USE OF FUELS *1st Semester*

Principles and practice of Coal Washing. A study will be made of Ore Dressing Machinery and principles as applied to washing of coal.

Coking, briquetting; use of fuels. 2 lectures or recitations, 6 hours laboratory per week. Prerequisite: Chem. 30, 39; Mine 2. Required in Group I.

20. THE CONCENTRATION OF IRON ORES *2nd Semester*
1 lecture or recitation, 6 hours laboratory per week. Prerequisite: Chem. 30, 39; Mine 2. Required in Group I.

OIL

Professors Johnson and Somers and Mr. Huntley

101. GEOLOGY OF OIL AND GAS *1st Semester*
Origin, accumulation and occurrence of oil, gas and oil shales. Methods of determining chances of success in locating oil and gas wells. 4 lectures or recitations, 3 hours laboratory per week. Prerequisite: Mining Geology 1. Required in Group III.

102. COMPARATIVE OIL FIELDS *2nd Semester*
A comparative study of the oil and gas fields and promising untested regions of the world. 4 lectures or recitations, 6 hours laboratory per week. Prerequisite: Oil 101. Required in Group III.

103. BUSINESS OF OIL AND GAS PRODUCTION *1st Semester*
Leasing, organization of companies, methods of cooperation in drilling tests and offsetting, operation on public lands, drilling contracts, natural gas industry, etc. History, leading companies. 2 lectures or recitations per week. *Prerequisite: Oil 101, 102; Geol. 101, 102. Required in Group III.

104. THE TECHNOLOGY OF OIL AND GAS PRODUCTION *2nd Semester*
Spacing of wells, drilling, pumping, transportation and storage. Increasing the percentage of recovery. Gasoline from gas. Distribution of gas. 2 lectures or recitations per week. *Prerequisite: Geol. 101, 102; Oil 101, 102. Required in Group III.

105. APPRAISAL *1st Semester*
Methods by which the value of oil and gas properties is determined. The methods of examination and of making reports upon properties. 2 lectures or recitations per week. *Prerequisite: Geol. 101, 102; Oil 101, 102. Required in Group III.

106. EXAMINATION AND REPORTS *2nd Semester*
The actual examination and preparation of a report of an oil or gas property. 9 hours per week. *Prerequisite: Oil 105. Required in Group III.

107. OIL AND GAS LABORATORY *1st Semester*
Exercises and investigations with oil field maps, geological maps, statistics, records of companies, cuttings from wells, etc., in the geology, business and technology of oil and gas. The work is partly individual and partly original. 12 hours per week. *Prerequisite: Geol. 101, 102; Oil 101, 102. Required in Group III.

108. Advanced Oil and Gas Laboratory *2nd Semester*
A continuation of Oil 107. 9 hours a week. *Prerequisite: Geol. 101, 102; Oil 101, 102. Required in Group III.

9. Chemistry and Refining of Petroleum *1st Semester*
A course on the chemistry, distillation and refining of petroleum. 2 lectures or recitations, 6 hours laboratory per week. Prerequisite: Chem. 39; Geol. 101, 102; Oil 101, 102. Required in Group III.

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*Otherwise properly qualified graduate students may take one or more of these courses with Oil 101, 102.

ECONOMICS

Professors Tyson, Reed and McKay

M-2. Principles of Economics *2nd Semester*
Fundamental concepts of economics, theory of value, production; present day problems of economics and an application of economic theory to the settlement of these problems. 5 lectures or recitations per week. Required in all groups.

M-3. Business Law *1st Semester*
Elementary principles of law as applied to common business transactions. Contracts, damages, principal and agent; negotiable instruments, etc. 2 lectures or recitations per week. Prerequisite: Econ. M-2. Required in all groups.

M-4. Contracts and Specifications *2nd Semester*
2 lectures or recitations per week. Prerequisite: Econ. M-3. Required in all groups.

M-5, 6. Economics of Mineral Technology *1st & 2nd Semesters*
Mining and allied industries; industrial management; labor problems; corporation finance; accounting; statistics. 5 lectures or recitations per week. Prerequisite: Mine 4, Econ. M-2. Elective.

SEMINAR

1, 2. *1st & 2nd Semesters*
1 lecture or recitation per week. Required in Group 1. *Dean Meller, Professors Black and Hill.*

103, 104. *1st & 2nd Semesters*
2 lectures or recitations per week. Required in Group I. *Dean Meller, Professors Black and Hill.*

5, 6. *1st & 2nd Semesters*
1 lecture or recitation per week. Required in Group II. *Professor Goodale.*

107, 108. *1st & 2nd Semesters*
2 lectures or recitations per week. Required in Group II. *Professor Goodale.*

9, 10. *1st & 2nd Semesters*

3 lectures or recitations per week. Required in Group III. *Professors Johnson and Somers.*

111, 112. *1st & 2nd Semesters*

3 lectures or recitations per week. Required in Group III. *Professors Johnson and Somers.*

113, 114. *1st & 2nd Semesters*

To be taken with Mining Geology 115, 116. Elective. *Professor Leighton.*

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UNIVERSITY OF PITTSBURGH
PITTSBURGH, PENNSYLVANIA

THE COLLEGE
SCHOOL OF ECONOMICS
SCHOOL OF EDUCATION
SCHOOL OF ENGINEERING
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GRADUATE SCHOOL
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SCHOOL OF PHARMACY

Separate bulletins are issued by each School and may be had upon application to the Registrar, 109 State Hall, University of Pittsburgh, Pittsburgh, Pa.